

# **New Developments in Lightning NO<sub>x</sub>**

**Ken Pickering**

**Laboratory for Atmospheres**

**NASA/GSFC**

**Lesley Ott**

**Dept. of Atmos. and Oceanic Science**

**University of Maryland**

**GMI Meeting – October 11-13, 2006**

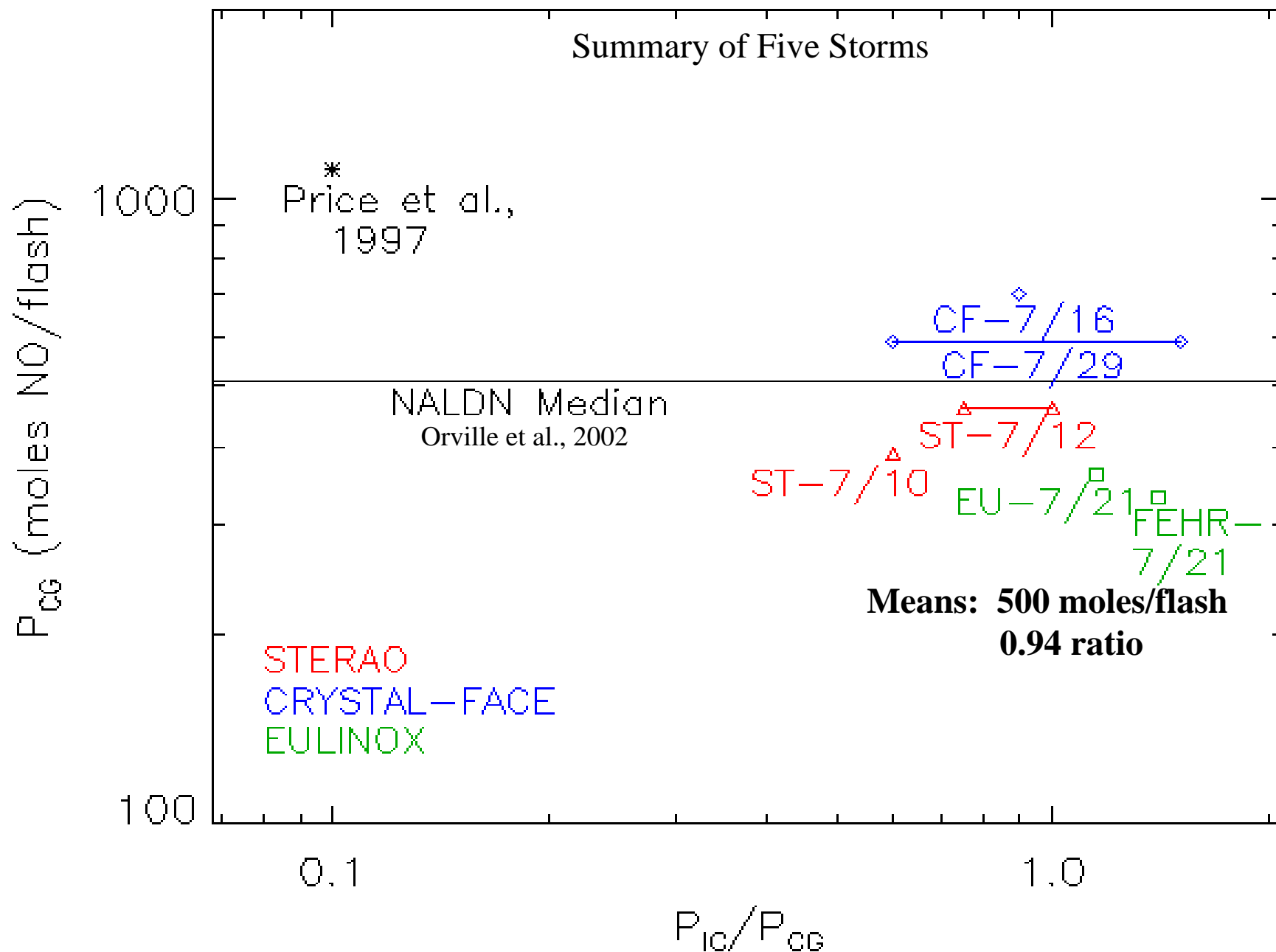
# Upcoming Activities

- We have provided lightning algorithms for use with the Combo model for running with GEOS-4 GCM and DAS fields at 2 x 2.5 deg.
- Planning for a next-generation lightning scheme, components of which derive from cloud-resolved chemistry and lightning simulations and new observations:

Production per flash

Revised vertical profiles

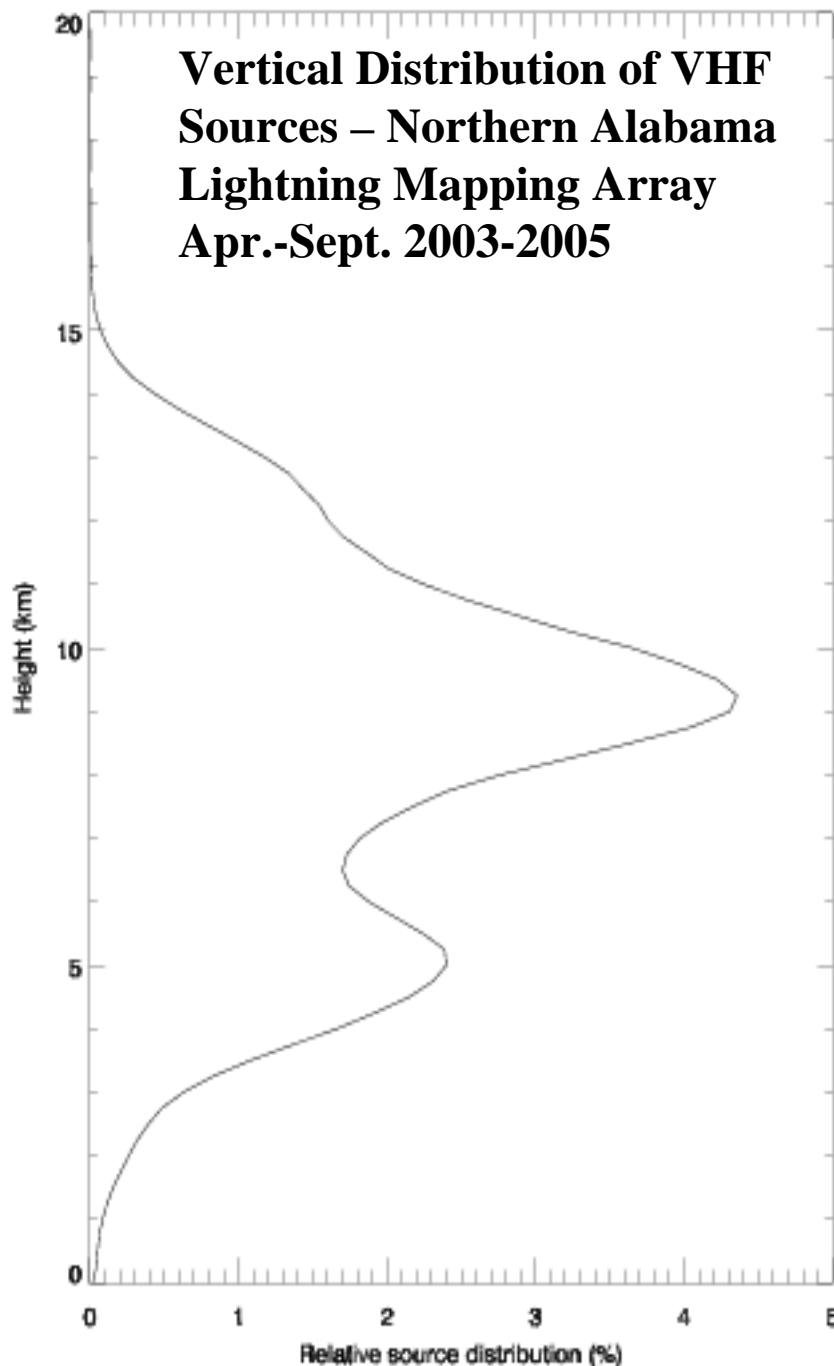
# Lightning NO Production Scenarios



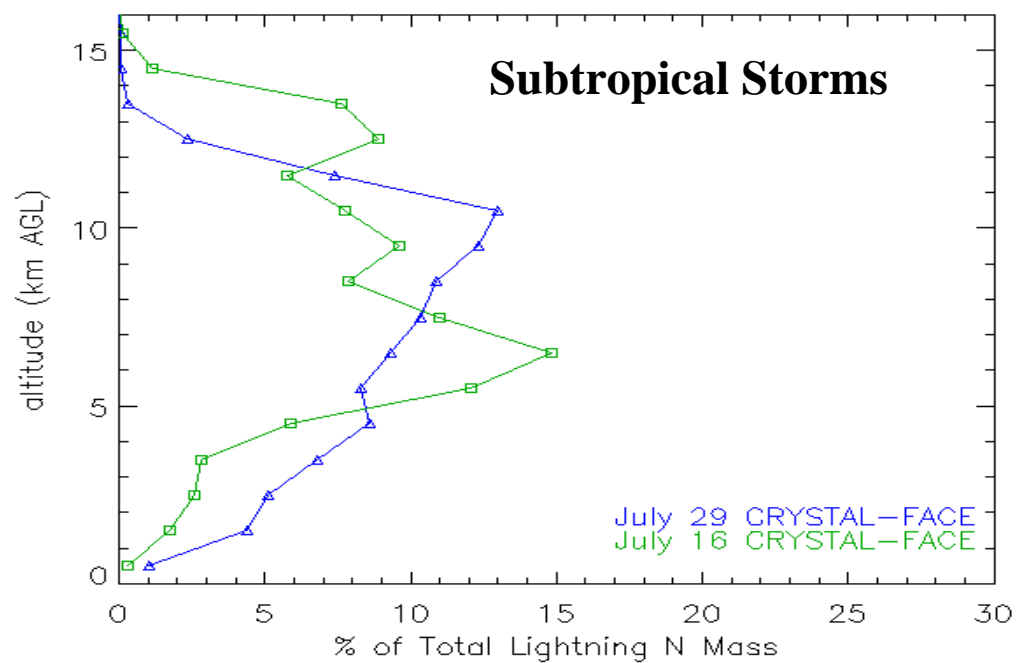
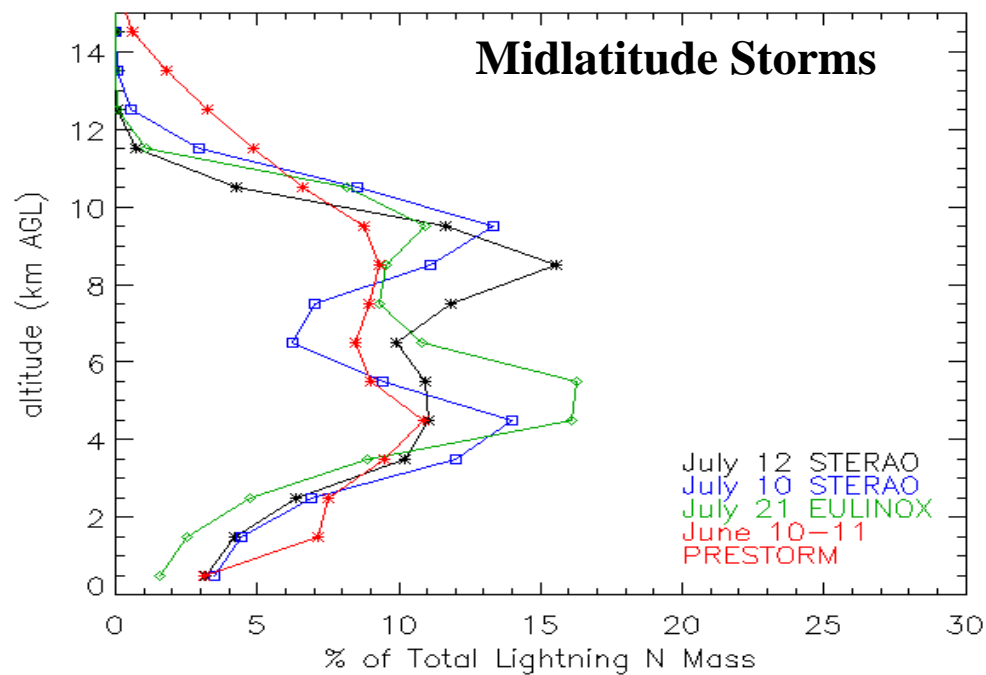
# Global Lightning NO<sub>x</sub> Production

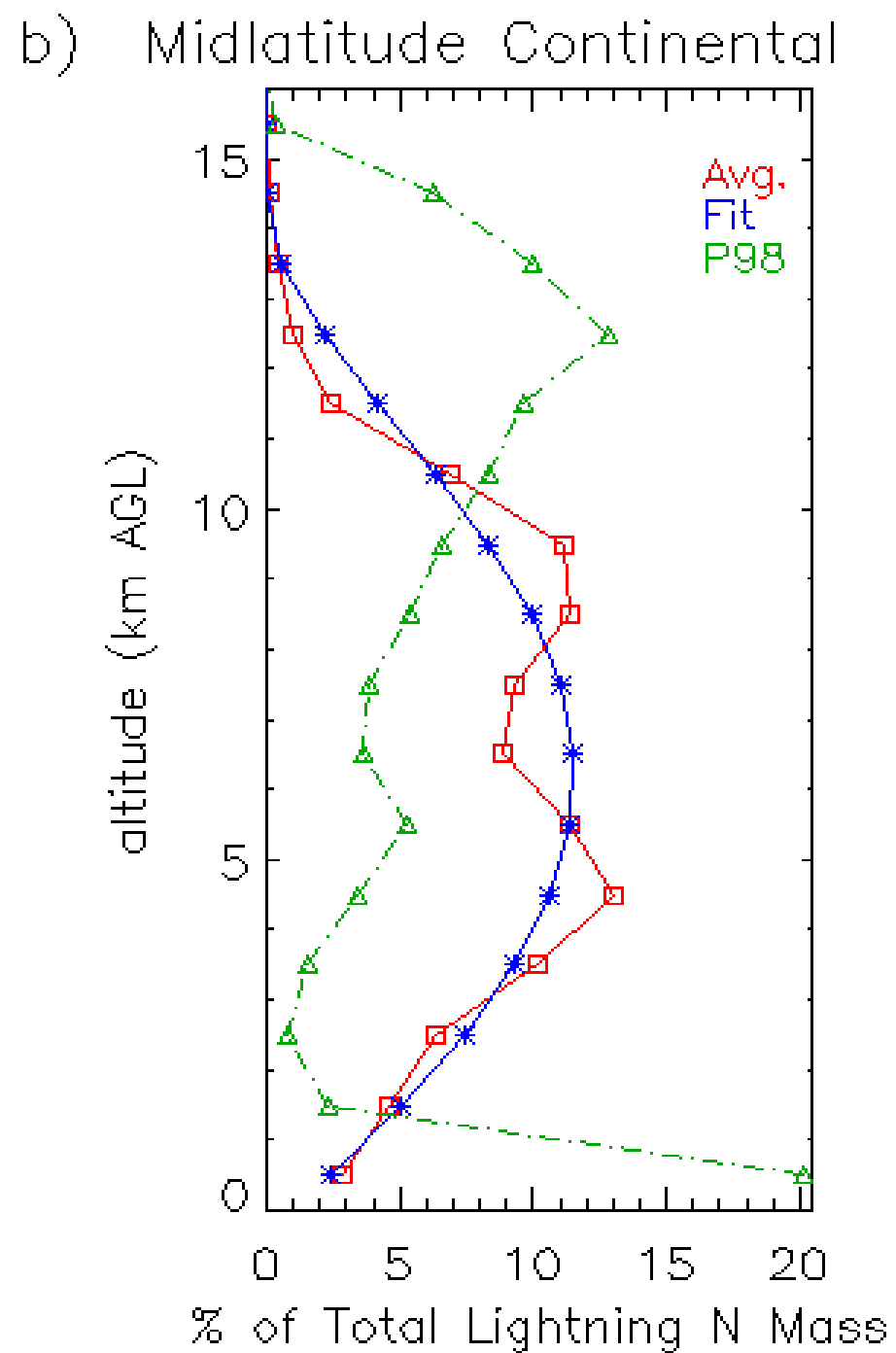
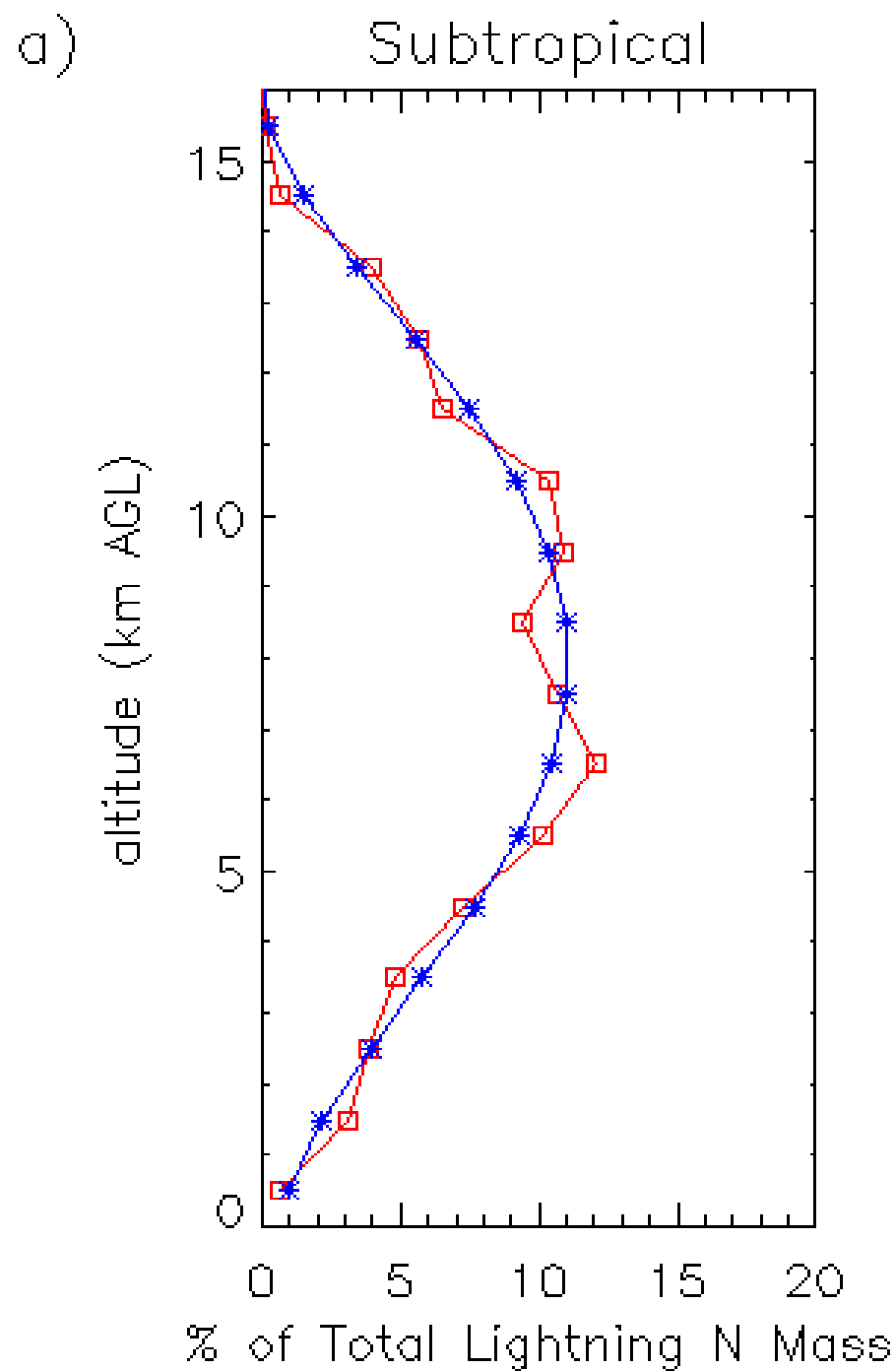
- Recent ICARTT modeling studies of Cooper et al. (2006, in press) and Hudman et al. (2006, in revision) used 460 and 500 moles NO/flash over North America, respectively, and obtained agreement with aircraft observations.
- However, this NO production per flash yields nearly 10 TgN/yr, which is likely too large. This has led us to think that tropical flashes may be less productive of NO per flash.
- Experimental evidence of this possibility comes from the TROCCINOX experiment in Brazil (Huntrieser et al, 2006, EGU; ACPD paper in preparation). Mean peak current and NO production per flash in German storm 1.5 – 2 times greater than in tropical Brazilian event.
- $500 \text{ moles/flash} \times 44 \text{ flashes/s} \times 0.3 + 236 \text{ moles/flash} \times 44 \times 0.7 \rightarrow 6.1 \text{ TgN/yr}$

**Vertical Distribution of VHF  
Sources – Northern Alabama  
Lightning Mapping Array  
Apr.-Sept. 2003-2005**

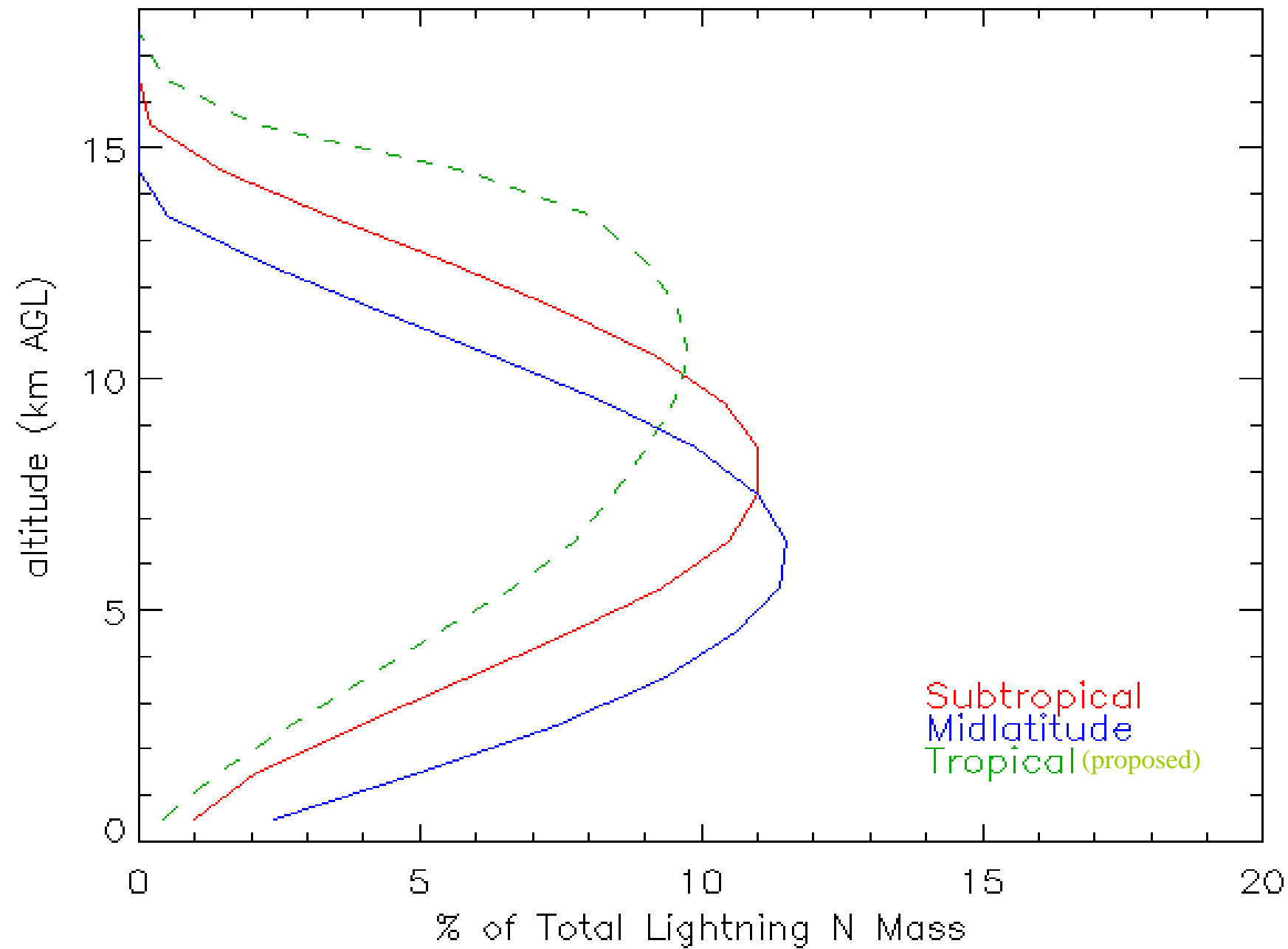


Similar shape factors  
used in cloud/chemistry  
model along with  
assumption of NO  
production being  
proportional to pressure





Regime Average Profiles



# Recommendations for Next-Generation Lightning Parameterization

- Change global source to 6 TgN/yr
- Adopt new vertical profiles:

|             |                 |
|-------------|-----------------|
| Tropical    | -20 to +20 deg. |
| Subtropical | 20-35N; 20-35S  |
| Midlatitude | 35-60N; 35-60S  |
- Consider variable NO production per flash (after more analysis of tropical data is performed)